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OF
FRACTURE OF THE SPINE,
IN WHICH
THE OPERATION OF TREPHINING WAS PERFORMED,
WITH OBSERVATIONS.

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UNSUCCESSFUL cases are often more instructive to the practical surgeon than those which terminate favourably; with reference to the subject which I propose to discuss in the following pages this is strikingly true, for I cannot help believing that thoughtful persons will be led to look favourably upon the operation of trephining the spine in certain cases of injury, as much from a careful consideration of some of the cases in which this operation has failed to save life, as from the account of those in which life has been actually saved by it.

It must be admitted that the question as to the judiciousness of trephining the spine, with a view to remove pressure from the spinal marrow, is one of the nicest which can be presented to the surgeon; and we know that surgeons of the greatest eminence are to be found ranged on both sides of the controversy—a controversy which, I regret to say, has not always been carried on with the calmness which should characterize such debates.

Before myself determining to recommend this operation, or to perform it if a suitable case should occur in my practice, I had very carefully studied what has been written both for and against it, and, so far as was possible, I had examined accurately the details of the published cases in which the operation had been performed. After due deliberation I had come to the conclusion that even on *purely theoretic* grounds, and viewed by the light which modern physiology and physiological experiment throw upon the subject, the weight of evidence lay on the side of those who, with Sir Astley Cooper at their head, advocate the operation. But in the advancement of surgery everything is essentially tentative, and results of cases must be the true criteria by which the most plausible theories are to be tested. An analysis of these results appears to me to lead irresistibly to the conclusion that in many instances this operation is good surgery; but in attempting to form a just appreciation of the value of the results of these cases, I do not intend to refer simply to those in which life seems to have been saved by the operative procedure; in not a few of the cases, which ultimately ran a fatal

course the improvement which followed the operation was at least sufficient to show that the removal of pressure from the spinal cord is the best method which can be adopted in order to try to break the chain of sequences which, when uninterrupted, leads the patient suffering from fractured spine so inevitably to the grave. The case which I have to detail belongs to this latter group:—

Joseph Collins, aged thirty-eight years, a thin, spare man, ordinarily employed at labour, was admitted to Jervis-street Hospital on December 28th, 1864. A short time before, while working in the hold of a vessel, from which a cargo of wheat was being discharged, a sack of corn had fallen upon him from a height of seventeen or eighteen feet. The weight fell upon the back of his head, neck, and shoulders; he sank beneath it, and to use his own expression, was “doubled up.” Immediately after the injury his lower limbs were powerless; he was at once conveyed to hospital, where I happened to be at the moment of his admission; I had, in consequence, an opportunity of examining his spine at the seat of injury before any tumefaction had occurred. I found that the spinous process of a vertebra, corresponding with either the first lumbar or the last dorsal, was more prominent than natural, while a marked depression, leaving no doubt whatever as to the existence of displacement between the vertebræ, was to be felt in the place of the spinous process of the vertebra above. When a circle was made round the body, at the level of the umbilicus, with a piece of cord, the prominent spinous process was found to be exactly four inches above this circle; it was accordingly fixed upon as being the spinous process of the first lumbar vertebra. The lower limbs were paralysed, as were also the bladder and rectum. The urine drawn off by catheter was not bloody. At a consultation on the afternoon of the day of the patient's admission, and again the following morning, I urged as strongly as possible the necessity for operation. I could not, however, induce the majority of my colleagues to take my view of the case.

It is hardly necessary to detail the progress of the case during the days which immediately followed; the loss of power of motion and of feeling became more marked than just after the injury; the urine dribbled away; the feces were passed involuntarily; on the ninth day the urine was neutral; on the eleventh alkaline, and containing copious muco-purulent deposit; a few days later it became bloody, and of a most offensive odour. Although placed on a water bed, and attended to most carefully, bed sores formed;

the penis became ulcerated, and the scrotum œdematous, and of great size. He suffered from thirst, flatulence, and pains over the bladder.

During the last days of January my friend, Dr. Brown-Séquard, happened to arrive in Dublin; he saw the patient with me, and thought that even still operation offered a chance for life, instead of certain death; the majority of my colleagues agreed, and with the patient's consent, indeed at his urgent request as soon as he understood the hopeless nature of his case, the operation was determined upon.

I now copy from my note book the details of the case from day to day.

Condition immediately Previous to Operation.—Dr. Brown-Séquard arrived in Dublin on January 30th; the following morning he accompanied me to visit the patient. He was then carefully examined, and was found in the following condition:—Pulse 100, regular, but feeble; tongue clean, rather dry; had rested tolerably well the previous night; no headache; complains of flatulence, and has a tendency to diarrhea; bladder completely paralysed; urine constantly dribbling away; no urine accumulates in the bladder; he is absolutely unconscious of the discharges passing per anum; and fluid feces ooze incessantly from the rectum; the penis is swelled, and the prepuce ulcerated from constant contact with the urine; there is an ulcer as large as a sixpence at the root of the penis, in the fold between the penis and scrotum, and the whole scrotum is swelled, red, and superficially excoriated; back, over the sacrum, ulcerated to a considerable extent, but, except in one small part, not deeply; at this one part matter can be pressed out, showing that the ulceration extends to some depth under the skin. Upon the inner ankle of left foot, and the outer ankle of the right two smaller spots (dry and scabbed) exist, where ulceration has occurred apparently without pressure of any kind having taken place. Paralysis of motion is almost complete in both lower limbs; in this respect they are exactly alike. On doing his best to produce a movement in the legs, a slight motion is perceived in each groin; the muscles of the thigh, calf, and toes are motionless; no reflex movement can be excited; sensation is normal along the thighs, over the skin of the calf and shin; rubbing or pressing on the sole of the foot is not perceived; he can, as regards the thigh and calf, distinguish the compass points at the usual distance, as in persons who feel normally; he can tell what part of the thigh or calf is touched by the hand, and in these parts

distinguish, with precision, heat and cold, and also pricking with a point. There is no difference in these respects between one limb and the other; in each foot sensibility is much impaired, and the sole of each is devoid of feeling altogether.

Operation.—I operated on February 3rd, 1865. My colleagues, Drs. Hughes, Stapleton, Banon, Tyrrell, and Forrest were present. Dr. Brown-Séquard was also present, and many surgeons of Dublin.

The patient was not removed from the ward or from the bed on which he lay. This was in order, as far as possible, to avoid disturbing any callus which might possibly have already formed. He was put under the influence of chloroform as he lay on his back in his accustomed position; when chloroformed, the bed was carried opposite to the window. The patient was turned over on his face; in this position the seat of the injury was obvious from the prominence of the last (?) dorsal vertebra. A small spot of ulceration, not so large as a sixpence, existed over the most prominent spinous process at this part.

An incision, nearly five inches long, was made with a strong scàpel over the spinous processes of the vertebræ (the last two dorsal and first two lumbar); then, with a strong curved bistoury, the slips of tendon on each side of the spines were divided. Keeping quite close to the bone the mass of muscle was detached on each side, and securely held apart by broad retractors, well suited for the purpose. The spinous processes, and laminae, in fact, the back of each vertebra as far out as the articulating process were thus fairly and fully exposed. The spine of each exposed vertebra was then taken hold of in a strong pair of necrosis forceps, and cautiously but firmly shaken to try whether any fracture of the posterior arch, or of the processes could be detected. No such fracture existed. (This I expected, as I had reason to suppose from the nature of the injury, that if any fracture existed it was one of the body of the vertebra).

On examination I was satisfied of the displacement existing in the parts with which I had to do; it was as follows:—The last dorsal vertebra (?) was as it were twisted, so that on the left side the inferior articulating process was raised up, and although not completely dislocated, yet it stood prominently backward from the corresponding process on the bone below; on the right side the superior articulating process of the same vertebra was in exactly the opposite predicament; it was displaced so as to be as if pushed in deeper than the process to which it corresponded on the vertebra above.

I determined to remove the spinous and inferior articulating processes of this vertebra, by cutting through the laminae. After waiting for a time while sponges and cold water were applied to stop bleeding, I first took off a part of the spinous process of the part I was going to remove, and divided the interspinous ligaments above and below. I next, with a strong pair of bone forceps, cut through the lamina on the patients left side (on which side I stood myself). This, owing to the displacement I have already described, was quite easily effected, as, of course the lamina, as well as the articulating process, was raised up somewhat on this side. On the right side, however, the opposite state of things made it much more difficult to succeed in cutting through the lamina. I could not succeed at first with the cutting forceps, but was obliged to use a Hey's saw guarded, so that it could not go in beyond a certain depth.

I was unwilling to use the saw, lest the unavoidable shaking might injure any callus already thrown out, and tend to undo any repair that nature had already commenced.

I finally succeeded in dividing the lamina on the right side with the forceps, I then grasped, in a pair of necrosis forceps, the root of the spinous process of the portion thus separated, and raising it cautiously, divided, with a scalpel, the ligamentous structures which now alone prevented its removal. On sponging away the blood, the theca vertebralis came into view; a small portion of the arch of the vertebra above was also removed with gouging forceps. The spinal cord was obviously pushed backwards, and had lain very close under the arch of bone taken away. The vertebral theca was not tense; there was no evidence of either blood clot or fluid being pent up within it; it was therefore not opened, although I had at first intended to do so.

Slight venous hemorrhage took place from the veins underneath the bone.

The operation lasted about an hour; it was protracted by long rests now and then, waiting until the sponging with cold water and infusion of matico checked oozing of venous blood, as it was necessary to see with great precision what one was doing. I do not think that more than five, or at the most six, ounces of blood was lost. A couple of sutures were put in at the upper part of the wound; the lower part was left open, a small tent of soft sponge alone being introduced.

Notes immediately subsequent to Operation.—The patient was replaced upon his back, pads of spongio-piline being placed above and

below the wound, and the sacrum protected by a circular cushion. He lay on a water bed, nearly flat, the head but slightly raised, and a cushion being passed behind the knees. He had an opiate enema; while being arranged a jet of urine was thrown from the orifice of the urethra; of this he was not conscious.

The same evening he commenced taking the 96th of a grain of atropine in solution, to be continued three times a day.

The bladder and the large intestine were carefully washed by injections of tepid water and thin flaxseed tea.

February 4th.—Day after operation; pulse 120, regular but weak; had rested tolerably, sleeping for a couple of hours at a time, some headache, and heat of head and skin; tongue dry, but not coated. When about to wash out the bladder, the urine was observed to come in a jet from the orifice of the urethra; bowels had not acted since the previous day, the opiate enema having checked the diarrhea; the pupil was not affected; the atropia was continued in the same dose as before; the penis and scrotum diminished in size, and the superficial ulceration better. In the afternoon, Dr. Brown-Séguard accompanied me to see him; we then found that sensibility had returned in the soles of the feet, and that a decided return of motor power had taken place in the muscles of the thigh. Complaints of cough, which hurts him—in fact, he had caught cold from the exposure during the operation. Ordered iodidi potassii three grains, in decoct. cinchonæ flavæ, along with the atropia.

5th Feb.—Pulse 108. Skin warm, but natural; tongue moist; had rested tolerably; no headache; appetite returning; had an egg for breakfast, and asked for a mutton chop for dinner; cough much less troublesome. Dr. Brown-Séguard again this day examined him along with me; we observed some œdema of the left leg and foot; sensibility is now almost, if not quite, normal all over the foot and sole. The sartorius, hamstring, and quadriceps extensor femoris muscles are able to contract with considerable strength; we can perceive no sign of movement in the muscles of the calf, or in the toes; their motor power is still absolutely wanting. Marked improvement has taken place in the state of the penis and scrotum. I dressed the wound and the sore on the sacrum, causing the patient to be raised right up by five assistants; after the application of the dressing, he was replaced on the circular cushions as before; healthy pus coming from the sore over the sacrum. When he coughs he feels pains across the back. Bladder and rectum washed out as before.

6th.—Pulse 100. Tongue moist; skin natural; altogether ap-

pears to be going on satisfactorily; has had a free evacuation from the bowels of natural appearance and consistence. He states distinctly that although not able to control the passing of the evacuation, he was conscious of its passage.

The bed-clothes underneath the patient were entirely changed; the wound and sore on sacrum dressed; the latter looking clean, and secreting healthy pus. Hitherto I should say that the most marked improvement which I can notice in the patient is that in the condition of the sores on the sacrum, and in those on the prepuce, penis, and scrotum.

Atropia continued, with decoct. cinchonæ and iodid. potassii. Eats an egg at breakfast, a chop, with porter, for dinner, and an egg in the afternoon. Bladder washed out several times a-day.

7th.—Appears to be making progress satisfactorily. I examined the condition of the lower limbs this morning, in presence of my colleagues, Drs. Lyons and Forrest; Dr. Beatty was also present, and the hospital class. I think I may say that sensation is now normal everywhere; he can tell (without being allowed to look at the part touched) when the finger is gently applied or rubbed over any part, even of the sole; he distinguishes heat and cold in the sole as well as elsewhere. The motor power of the muscles of the thigh is much increased; the patella is moved with some force; as yet the muscles of the calf and toes are incapable of movement. Diet as before; atropia slightly increased; iodide of potassium and bark continued. Washing of the bladder continued several times daily.

8th.—Had a good night. Pulse 100; sores looking well; œdema of left foot nearly gone. Wound and sore on sacrum carefully dressed; bladder washed. Atropia has decided effect on the pupil. No observation made this day on sensation and motion of lower limbs.

9th.—Rested very well. Bowels freely moved without control, but with consciousness of the movement; penis and scrotum much reduced in size; œdema of left leg nearly gone. No particular examination of motion and sensibility made this day. Wound suppurating, and apparently going on favourably.

10th.—Had not a good night, yet does not seem worse as regards his general condition. Pulse 108; tongue clean and moist; bowels not moved during last twenty-four hours. For the first time to-day I observed distinct reflex movements of the muscles of the thigh, on touching or plucking the hairs on the inside of the thigh; in other respects as before. Atropia continued. Cough is rather troublesome; he attributes his restless night to this, not to pain; he has no referred sensations of pain in the lower limbs.

11th.—Pulse 108, and in other respects the same as yesterday; well-marked voluntary movements in all the muscles of the thigh; none in the calf or muscles of the toes; no reflex movement in the calf or toes from touching or tickling the leg or sole. Reflex movements in the sartorius and adductors are to-day well marked, when the hairs on the inside of the thigh are plucked. Scrotum and cremaster also give reflex movements. The condition of the penis and scrotum much improved. The wound was dressed to-day; a copious discharge of pus, dark with blood. Bed sores on sacrum improved, and discharging healthy pus.

12th (Sunday).—After being dressed yesterday he had a severe rigor; this may be due to the almost unavoidable exposure to cold while the cloths underneath him are being changed. Bowels moved this morning; feces natural in appearance and consistence.

13th.—Pulse 100, feeble; sickness of stomach came on last night; is afraid to eat for fear of bringing on vomiting again. I injected the bladder to-day with turpentine 3i , made into an emulsion, with yolk of egg; it produced no pain. Atropine is still continued; iodide of potassium stopped, as he fancies it causes sickness. Wound dressed to-day; edges very red.

14th.—Passed a good night; is altogether better to-day; pulse 100, and stronger; vomiting ceased; took his egg this morning.

15th.—Passed a quiet night; sleeps a good deal; bowels moved to-day; no material change since yesterday. The bladder is washed out daily with the turpentine emulsion, and I think I may say that the condition of the urine washed out indicates some improvement in the state of the bladder. The urine is certainly much less offensive, and the mucus, which was at first increased by the turpentine, is now diminished in quantity. Wound dressed; a large discharge of healthy matter; the bed sores are clean, and in a healing state.

16th.—To-day, for the first time, there is a marked improvement in the power of expelling the urine, on trying to do so.

17th.—Pulse 120, weak. Passed a quiet night, free from pains; he sleeps a good deal both by day and night; can now drive the water out of the bladder with a considerable degree of force. Motion, sensibility, and the reflex phenomena are in the same condition now for some days, neither getting better or worse. Scrotum quite pursed up, and of natural dimensions; penis parboiled, and swollen round the prepuce, but of natural size in other respects; bed sores going on well; wound secreting a large quantity of matter.

18th.—Had a rigor yesterday after being dressed; sickness has returned to-day; brandy and water freely given.

19th (Sunday).—Pulse 125, very weak. Felt very weak to-day when being dressed. Bowels moved; discharge thin, and indicating diarrhea; sickness continuing, not checked by ice, hydrocyanic acid, &c. Bladder has been washed daily with the turpentine emulsion as before. I believe the condition of the bladder to be certainly improved, and the voluntary power over it so likewise. He says he did not sleep at all last night, but does not know what kept him awake as he had no pain. The urine continued alkaline throughout.

He died rather suddenly on the morning of the 20th, having been seen by the resident pupil about an hour before, and reproved for smoking, which he had been found doing by the night nurse. He was then apparently quite himself, and not in pain.

Post mortem examination, made the same day (20th), in presence of the pupils. Body much wasted; no œdema.

Head.—Considerable subarachnoid effusion, also some clear serum in each lateral ventricle; brain and its membranes healthy.

Chest.—Lungs healthy, indeed remarkably so; no old adhesions; heart normal; no fluid in pericardium.

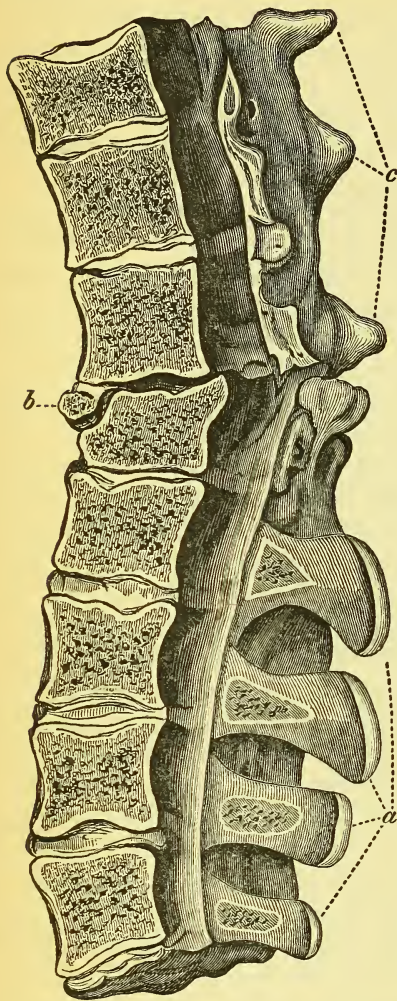
Abdomen.—Stomach and intestines healthy; no lodgement in any part of bowels; no ulceration in the rectum or other parts of the large intestine.

Urinary bladder contracted to a small size, greatly thickened, and containing small collections of pus in its walls. Mucous membrane ulcerated, and covered with ash-coloured shreds of adherent membrane; both ureters thickened, so as to be as thick as the little finger; the mucous membrane lining each was in the same condition as that of the bladder, and on the left side this extended all the way up to the kidney, the pelvis of which contained pus; its structure was disorganized by abscesses.

On examining the bodies of the vertebræ on their anterior aspect there was no inequality which made it obvious that an injury had taken place. The lumbar and lower dorsal vertebræ were removed; the spinal cord and its membranes were taken out by cutting through the laminae of the dorsal vertebræ. Subsequently the section shown in the accompanying woodcut (Fig. 1) was made. The dura mater of the cord was uninjured; the portion of it corresponding to the piece of bone removed at the time of the operation was covered externally with lymph; the surface next the cord was healthy; there was no trace of inflammation within the dura mater. The cord was not inflamed or softened; it was indented at a point

corresponding to where the bone was displaced; and when the finger was passed along it gently it felt as if softened at this indentation, but there was neither red nor white softening of its structure, and this feeling was merely the result of pressure, which had not given rise to structural disorganization.

Fig. 1.



The body of the first lumbar vertebra was fractured, and this vertebra was displaced backwards; the line of fracture separated only a small portion of the body of the broken vertebra. The intervertebral substance between the last dorsal and first lumbar vertebræ had been torn, and the body of the first lumbar was displaced backwards, as shown in the accompanying woodcut. A small blood-clot occupied the space above the projecting body of this vertebra, lying between the body of last dorsal vertebra and the anterior aspect of the dura mater of the cord. The spinal cord was, therefore, pushed backwards by this effused blood, as well as the body of first lumbar vertebra, not simply by the sharp ridge of bone, as might be at first supposed from looking at the woodcut.

Fig. 1 represents a vertical section of the inferior part of the spinal column, as seen in the case of Collins (the lumbar vertebræ and the three last dorsal): *a*, the spinous processes of the last four lumbar vertebræ; *b*, the small portion broken off from the body of first lumbar vertebra; *c*, portions of the last three ribs. As the cord was pushed backwards, not only by the projecting body of first lumbar vertebra, but by the blood-clot filling the hollow above this projection, it is obvious that the complete removal of the posterior arches of both the last dorsal and first lumbar vertebræ would have set the cord free from pressure.

It was, of course, corresponding with this part that the indentation existed upon the spinal marrow.^a

As a sort of appendix, at the conclusion of this communication I have given a table of reference to all the cases which I have been able to find out in which an operation has been undertaken to remove portions of bone pressing on the spinal marrow. These amount to twenty-six cases, in seven of which life has been preserved, viz.:—No. 1, Louis'; No. 9, Alban Smith's; No. 13, Edwards'; No. 16, Walker's; No. 17, Blackman's; No. 23, Blair's; and No. 24, Potter's (twice operated upon). Although it must be admitted that the details of these cases are in some instances meagre and unsatisfactory, yet the fact of the cases having occurred can hardly be denied. I have already said, however, that the improvement which took place in some of the cases which ultimately terminated fatally is a result which shows not only that good is in many instances derived from the operation, but that some of the arguments used against an operative procedure are not well founded. In my own case this improvement was well marked; it was evidenced by return of sensation, increase of motor power, return of the possibility of exciting reflex movements, but, above all, by the altered condition of the penis, scrotum, and bed sores. Tyrrell says after the operation in his first case:—"The patient could now feel distinctly on being pinched on the inside of the thigh, which *immediate return of sensation was beyond my most sanguine expectation.*" Mr. Wickham tells us—"The operation was easily performed, and the patient was in a degree relieved by it; his breathing became more free, and *sensation returned to a considerable extent.*"

In Holscher's case, eight weeks after the injury, sensibility returned in the feet; some week's later movement of the legs was possible. In Jones' case the amendment was so remarkable that I shall be pardoned for transcribing the case in full:—

"J. G., aged 34, a tall and remarkably muscular man, by trade a carpenter, was brought into the hospital, at 3 p.m., on the 28th February, 1856, in consequence of an accident he met with three-quarters of an hour before his admission. While employed on the deck of his vessel, his foot slipped, and he was precipitated into the hold, his head, at the same time, coming in contact with a block ;

^a These parts were exhibited at the meeting of the Pathological Society, February, 1865, and are preserved in the Museum of the Carmichael School of Medicine.

he was taken up in a perfect state of insensibility, and shortly afterwards was seen by Dr. Marett, who accompanied him to the Hospital, where he was immediately attended to. It was evident that he then laboured under the effects of liquor, the breathing was rather stertorous; pulse 38, soft and feeble; pupils natural; excessive priapism. With the exception of a slight abrasion over the right eyebrow, there existed no sign whatever of external injury; the extremities were cold, so that hot water bottles had to be applied to them. When seen at 9 p.m. he had entirely regained consciousness, and complained of pain in the neck, and great uneasiness between the shoulders; also slight pain in the head; had sensation along the arms, but not in the fingers; there was entire paralysis and loss of sensation from the sternum downwards; breathing was consequently performed by the diaphragm alone. Pulse 54; no irregularity in the line of spinous processes was perceptible; the head was thrown backwards, and the integuments at the back part of the neck presented three or four folds running transversely. A strong cathartic was at once ordered, and ℥xviij. of healthy-looking urine was drawn off by means of the catheter. From this date up to the fifth evening after the accident no melioration took place; on the contrary, the patient slowly, but gradually, became worse; the catheter had to be introduced three and four times in the twenty-four hours, as all power of voiding urine was completely lost; the bowels were only acted on by means of croton oil; assisted by enemata; the pulse varied from 50 to 60; and, notwithstanding the precautions taken, a large sore on each of the nates had already commenced sloughing. On the 2nd March the sufferer was placed under the influence of chloroform, in order that a more minute examination of the spinal column might take place; the result was as unsatisfactory as the first. When seen on the 5th, at 9 a.m., a marked change for the worse had evidently taken place; a great tendency to lethargy, which had never before manifested itself, was apparent; and when roused, the countenance expressed considerable anxiety; the sensation along the arms was more deadened; speech thickened; and the pulse intermitted at every third and fourth beat. Under these most unfavourable circumstances, the following operation was performed, the patient having first been rendered insensible by means of chloroform:—

“An incision, about four inches in length, was first made on each side of the spinous processes of the third and fourth dorsal vertebræ, and were then connected together in the form of the letter H, by a

transverse one. As much of the muscular structures, together with their integuments, as the nature of the parts would allow, were then reflected upwards and downwards. The muscular mass on each side of the spinous processes, and that covering the vertebral arches, had to be cleared away, in order to expose those parts; this accomplished, the arches of the third and fourth dorsal vertebræ were sawn through close to their pedicles, and their interspinal attachments being loosened, were removed, so that the cord, covered by its membranes, was exposed; but little effusion of blood was found here, and no fracture could be detected; the incisions were, therefore, prolonged upwards, and, on exposing the lamina of the fifth and sixth cervical vertebræ, much ecchymosis was discovered, and the fracture detected. The same proceeding was adopted over these vertebræ as in the first instance, and the cord and its membranes exposed; the arches were fractured across; the membranes were not lacerated, but roughened; and there was much blood effused between them and the vertebral canal. After the removal of the fractured portions, the lips of the wounds were approximated by means of adhesive plaster, and water dressing, &c., applied. The hemorrhage was very abundant, though not serious, and chiefly of a venous character. The pulse after the operation rose to 80, and no longer intermitted. At 8 p.m. the patient had entirely recovered from the effects of chloroform; merely complained of smarting pain in the neck and back; was perfectly cheerful, and *had recovered sensation as low down as the umbilicus. The arms, too, which before the operation could only be drawn upwards, were now raised at pleasure, and could, without inconvenience, be thrown across the chest.*

“6th.—Slept comfortably during some parts of the night; pulse 70, and regular; sensation, as low down as the umbilicus, natural; has on several occasions felt the desire to void water, and has asked for the urinal two or three times; the power is, however, still wanting, and the urine has been drawn off. (It may here be stated that, from the time of the accident till the patient's death, this secretion was always sufficient, natural in character, and never once emitted the slightest ammoniacal odour.) On the 7th and 8th the improvement was gradual; and, at 1 a.m., on the 9th, I had some reason to hope that recovery might take place. I found he had slept well for five hours. He expressed himself as refreshed, was very cheerful, desired food, and gave it as his opinion that the catheter would not again have to be employed. Pulse was then 73, soft, and regular. At 5, his bowels were freely acted on from croton-oil pills, taken

the preceding evening. His linen was at once changed by the nurses, when almost immediately afterwards coma came on, and he expired at 10 o'clock the same morning. As the patient's relations were anxious to remove the body as soon as possible, the *post mortem* examination was of necessity a partial one, and, consequently, by no means as satisfactory as could have been desired. It showed the spinal cord to be entire and unlacerated in its posterior aspect. To the left side, opposite the pedicles, and passing obliquely across, and corresponding to the seat of the fracture through the bodies of the fifth and sixth cervical vertebræ, the cord bore the appearance of injury. Much blood was found in the neighbourhood of the fractured parts, and so complete was the injury and displacement, that the bones were preserved in their natural position almost entirely by the integrity of the anterior common ligament. The roots of the spinal nerves on the left side were in a great measure severed from the cord. There was considerable effusion at the base of the skull, and the muscles and structures on the back were congested."

I conceive that the amendment which was observed to take place in the cases to which I have now referred, offers the best answer to what has been urged as a cogent reason for non-interference in cases of fracture of the spine, viz., that as, in the great majority of instances of this injury, the fracture traverses the body of the vertebra, a displaced portion of which causes a diminution in the size of the canal, and as this portion is not accessible to an operation, it is argued that such a proceeding can be of no avail.

To give Sir Benjamin Brodie's^a own words, "The question respecting such an operation seems to me to lie in a very small compass; if the whole or nearly the whole of a vertebra be driven forwards, the depression of the posterior part of it will, of course, occasion a diminution of the size of the spinal canal; but the removal of any portion of the vertebra, which is accessible to an operation, will be of little avail, as the irregularity in the anterior part of the canal, made by the displacement of the body of the vertebra, must be the same after, as it was before the operation." Mr. Alexander Shaw puts very strongly the same argument,^b "Specimens," he says, "preserved in museums, prove it to be a

^a Med. Chirurg. Transactions. Vol. xx., p. 160.

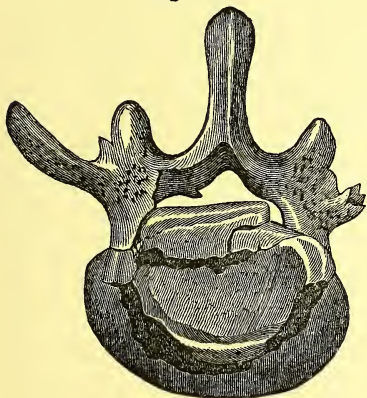
^b A System of Surgery by Holmes. (Article—Injuries of the Back. By A. Shaw. Vol. ii., page 236).

general fact, that the fragments of the broken vertebræ, which are indented into the cord and commit the greatest injury, are in front, not behind. It does not appear, therefore, that benefit can possibly be gained, so long as the principal cause of compression continues to exist on the fore-part, by extracting portions of the posterior arches."

This line of reasoning has carried great weight with many; and I confess that it at first seemed to me the gravest of all objections offered against the operation in question.

The impartial enquirer will, I conceive, find the refutation of it simply in the facts shown in the cases already cited, which prove that benefit *has been gained* by extracting portions of the posterior arches; that motion and sensation have, more or less, completely returned, and ulcerations healed; in short, that the spinal cord has, to a certain extent, recovered its powers, and that, too, in cases in which the examination after death has shown the circumstances to be precisely those in which it would appear to Mr. Shaw that no benefit could possibly be gained. Sir B. Brodie's observation is, no doubt, quite true, that the irregularity in the anterior part of the canal, made by the displacement of the body of the vertebra, must be the same after as it was before the operation; but if the cord is pushed backwards, so as to be actually squeezed against the posterior arch, clearly the removal of the arch gives it room. Taking

Fig. 2.



away the spinous process and laminae in such a case as is figured in the accompanying woodcut (Fig. 2), would, without doubt, take pressure off the cord; and in my case the complete removal of two arches, as will be seen by looking at the woodcut (Fig. 1), would have set the cord completely free from pressure. The cord would, indeed, have still passed over an eminence, caused partly by bone, partly by the blood clot in front of its dura mater, but, the source

Fig. 2.—Showing a fracture of the body of a lumbar vertebra. The woodcut is copied from Dr. Gurlt's work on fractures (*Handbuch der Lehre von den Knochenbrüchen* von Dr. E. Gurlt), and is taken from a preparation belonging to Professor Middeldorp. It is obvious that in such a case, although pressure is caused by the fractured body, yet that it would be relieved by taking away the posterior arch.

of counter pressure being removed, we know very well that passing round an abnormal curve, even greater than this, does not prevent the spinal marrow from exercising its functions. I regret that in my case the posterior arch of the last dorsal vertebra was not taken away completely; it would have added little to the severity of the operation, and nothing to the danger, and would more thoroughly have taken pressure from the cord.

Although Boyer was opposed to the operation, yet one at least of the four cases which he adduces seems to give little support to the opinion which he forms.

“A sack of flour weighing three hundred pounds, fell on the nape of the patient’s neck; an acute pain was felt in the lower part of the cervical region. The patient was conveyed to the Hospital of La Charité; on examining him I perceived that the spinous process of the seventh cervical vertebra was more prominent than in the natural condition. The upper and lower limbs were paralyzed; respiration laborious; the rectum and bladder incapable of acting. The patient died at the end of five days. At the *post mortem* examination we found a fracture of the posterior arch of the seventh cervical vertebra, with depression of a fragment which pressed on the spinal marrow, and exercised upon it firm compression.”

The recorded cases of trephining of the spine show how groundless are the theoretic objections conjured up against this operation by Sir C. Bell; those persons, at least, who witnessed the operation in my case well know that he is quite in error in speaking of the great “degree of violence necessary for the performance of the operation,” and those pupils who saw the patient’s condition before and after the operation, and who watched his progress from day to day, will, I fancy, laugh at the ridiculous assertion that “the man must be already dead whose condition is not made worse by such an operation as this.” Sir Charles Bell asserts that even if a sharp piece of bone were driven into the spinal marrow, causing paralysis of the lower limbs, that exposing the medulla to extract the fragment would so aggravate the mischief that inflammation, suppuration, and death, would be the inevitable consequences. This assertion experience has contradicted, and as a matter of fact, we know that the operation is not likely to be followed by inflammation and suppuration of the cord or its membranes. Indeed, as regards the occurrence of meningitis, it is natural to suppose

that in trephining the spine this would be less likely to occur than in trephining the skull, as in the latter case, the dura mater is very closely adherent to the bone; while in the former it does not constitute a periosteal lining for the bone, which is without difficulty detached from it.

Liston also speaks of the chance of inflammatory action being increased by operation, to which he is decidedly opposed. Mr. Alexander Shaw draws a terrible picture of the inflammation and suppuration which he fancies is likely to follow:—"Let any one," he says, "consider the ulterior effects which may be reasonably expected to follow, in general, from such a wound as must be inflicted in trephining the spine. The incision must be both long and deep, being made through the skin and the muscles, and through the blood infiltrated in the torn structures, down to the broken bone. The main object of the proceeding being to remove the fragments, and to lay open the vertebral canal, the external wound will communicate not only with the fractured surfaces but with the interior of the canal which contains the spinal cord. To the mind of the surgeon accustomed to witness the disastrous effect of compound fractures, the condition here described must appear the most formidable that can be conceived. He will look forward (if the patient should live) to profuse suppuration being soon established; to the pus penetrating extensively along the vertebral canal, between it and the membranous theca, to the exposed and the isolated ends of the fractured vertebræ becoming necrosed, and he will not expect that, until these be detached and cast off (a process requiring many months for its completion), the suppuration will cease or the wound cicatrise."

The reply which I would give to all this is very brief; it is simply this: within the present year I have seen this operation twice performed in this city; once by myself, on a patient who survived the operation seventeen days, and once, six weeks ago, by my friend Dr. Gordon, on a case which is at the present moment going on favourably; and that in neither the one nor the other of these cases were the terrible expectations of Mr. Alexander Shaw realized.

The wounds, of which one was about five, the other a little less than four inches long, suppurated, and granulated healthily, and were not sources of any considerable discomfort to the patients.

Meningitis, going on to suppuration, was not a cause of death in any of the recorded cases in which *post mortem* examinations were

made after the operation. In Oldknows' case, and indeed in Holscher's, the dura mater was thickened, and the pia mater of the cord vascular; in Meyer's case the spinal marrow was softened; as however, in my own limited experience, I have seen three patients, not operated on, carried off in great suffering by suppurative meningitis, the whole cord being bathed in pus; I must rather incline to the opinion that trephining tends more to prevent meningitis than to cause it.

Those surgeons who are opposed to the operation of trephining the spine are of course anxious to show that cases of fracture of the spine are not in all instances fatal; and it is obvious that before any surgeon would be willing to incur the weighty responsibility of recommending this operation to his patient, the very first thing he will do will be to inquire what may be the probable chances for life in cases left without operative interference. We have not, unfortunately, anything like accurate statistical information on the subject. It is well known, however, that recovery under such circumstances is extremely rare: as Jones observes, in common parlance, when it is said that a man has broken his back it is generally regarded as synonymous with his having met his death. Mr. Shaw mentions two cases of recovery: the first is that of a patient who recovered (with paralysis remaining) from fracture in the dorsal region, and who was seen by him in perfect health otherwise, more than twelve years after the accident. The second is that of a man who had fracture and paralysis in his youth, who shortly afterwards recovered sensation, and the power of motion in his limbs, so as to be able to follow an active occupation, who, after a period of seventeen years, had a return of the paraplegia, and lingering for five years in that condition, died under the observation of Mr. Shaw, who had the opportunity of examining the body.

He narrates also a very remarkable case communicated to him by Mr. Page, of Carlisle, in which a gentleman, twenty-six years of age, survived, for nearly fifteen months, an injury of the fifth (or fourth?) cervical vertebra, the body of which was broken, almost severing the spinal marrow.

Cases such as that detailed by Mr. Hilton, in which a patient with fracture of the cervical vertebræ, accompanied by complete paralysis of the arms, legs, bladder, and rectum survived for fourteen years; or Mr. Phillips's^a well-known case of fracture of the

^a *Medico-Chirurgical Transactions*. Vol. xx., p. 78.

atlas and axis, are looked upon with an amount of astonishment which is in itself the best proof of their scarcity.

Sir Astley Cooper alludes to two cases in which union by ossific matter had taken place; in one of these the patient died in twelve months, wanting nine days, after the injury, owing to a sore on the tuberosity of the ischium and disease of the bone. The bodies of the first and second lumbar vertebræ were found to have been fractured and united by ossific matter. In the second the history of the case was not known, but the fracture was united by ossific matter.

In the museum of the Royal College of Surgeons of Edinburgh there is a fracture of the vertebræ, in the dorsal region, which united by callus, although the patient only survived the accident about two months.

Mr. South has notes of a case in which union of a vertebral fracture, accompanied by perfect palsy of the lower limbs and bladder, ensued, and the patient continued improving for ten years; and he has in his possession two preparations of cases in which the patients lived long enough to have callus thrown out at the seat of fracture. Most practical surgeons will agree with him and Jæger that "many cases of pretended union of fractured vertebræ are very suspicious, and may have been only mere bruising, stretching of the ligaments, or concussion of the spinal marrow." I have heard, indeed, of some wonderful cases of recoveries from fractures of the spine, but one is forced in these cases to doubt the correctness of the diagnosis on reflecting upon how few are the specimens in our museums of cases like that mentioned by Mr. Shaw, where years after the injury *post mortem* examination revealed that fracture had actually existed.

I would remind my readers also that in some cases of ankylosis of the vertebræ, resulting from disease, the condition is not unlikely to be confounded with ankylosis arising from the effects of injury. Chronic rheumatic arthritis, which has little, if any, tendency to produce ankylosis elsewhere, has a tendency to do so in the spinal column, and that too in a manner which, without careful examination, might be mistaken for ankylosis, the result of fracture. A preparation indeed of this kind, in which ankylosis existed between the second and third cervical vertebræ, was accompanied by appearances so remarkable as to induce some of those who examined it to think that injury, with fracture, had been the cause of it, yet from the history of the case it was certain that it was due to nothing of the sort, but resulted from rheumatic disease, with an unusual

congenital formation. It is therefore possible that some specimens, of the history of which nothing is known, may be supposed to be united fractures or displacements where ankylosis has followed, which really are not so.

It is certain, however, that cases of recovery from fractures of the spine, with symptoms of compression of the cord, are of extreme rarity; one per cent. is greater than Sir Astley Cooper met with in his experience. The proportion of cases in which, after operation, life was preserved shows a per-centage which contrasts very favourably with this.

But it may be said if the correctness of diagnosis is to be doubted in cases which live without operation, is it not equally doubtful in those where patients do not die after the operation. This is of course true, and this is precisely the reason that in attempting to form a fair judgment of the merits of the operation in question I conceive that in one point of view the unsuccessful cases afford stronger testimony in favour of it than those reported as successful. In the one set of cases we remain in the dark as to the precise nature of injury; in the bulk of the unsuccessful cases, where *post mortem* examination left no doubt as to the nature of the injury, enough of improvement has followed to prove incontestably that the theoretic arguments urged against the operation are not well founded. Those cases, however, in which patients have survived the operation have a great value even if it be supposed that in no one of them was a fracture really existing; they show that there is nothing in the operation of trephining the spine which, of necessity, must cause death; they show, if nothing else, at least that the "inevitably fatal" predictions of Sir Charles Bell, and the gloomy forebodings of Mr. Alexander Shaw are equally unverified by facts.

It must not be forgotten that some of the most eminent British surgeons who have ever lived have spoken favourably of the operation of trephining the spine. "Let the young surgeon's mind," says Mr. Shaw, "be fortified against the influence of the authority in favour of the operation given by certain great men in the profession." I would indeed, in the consideration of such a question, repeat let the surgeon's mind be fortified against the influence of authority; let him rather consider the facts of the case, and what is said, than who it is that says it. I refer therefore to the observations of Abernethy, Benjamin Bell, Cline, Sir Astley Cooper, South, &c., not in order to call in the influence of the authority of their names, but to show that surgeons of vast experience regarded

fracture of the spine as an injury of so fatal a character that they judged favourably of an operation which seemed to them to give a chance of saving even one life out of many.

Abernethy, with characteristic caution, says of the operation, "I think that it is a proposition too hardy to be acquiesced in; but I see in it nothing but what is rational—it is the only mode that occurs to one's mind."

Benjamin Bell speaks more strongly:—"Wherever," he says, "the spinal marrow appears to be compressed, and where there is reason to think that the compression is produced by the depression of a portion of bone, as we know from experience that every such case will terminate fatally, if the cause of compression be not removed, it would surely be better to endeavour to raise it, than leave the patient to certain misery and death. By laying the injured parts freely open we may be enabled to raise that portion of bone by which the compression is produced; while, in such circumstances, it cannot add to the hazard of the patient, even allowing the attempt to prove abortive. In a case where symptoms of paralysis were induced by a musket-bullet lodged in the substance of one of the vertebræ, a complete recovery was obtained by extracting the bullet. A portion of depressed bone might often be removed with equal ease and safety; and there is reason to suppose that similar effects would often result from it."

Sir Astley Cooper, as is well known, thought well of the operation. In his lectures he says, that "the proposal is laudable, and the operation not severe, nor does it increase the danger of the patient; time and experience can alone determine its value. If we could save one life in a hundred by it we should deserve well of mankind, and if any good does ultimately result from it, Mr. Henry Cline^a

^a In this Sir Astley Cooper was in error; the operation was performed by Louis before Henry Cline's time; and it was more than a hundred years ago, at least, recommended, if not performed, by Heister. He says:—"Wenn aber die Fractur so gross und heftig, dass dadurch das Rückenmark selbst gequetschet und verletzt ist, so folget gemeinlich bald der Tod. Dennoch, weil auch solche Patienten nicht zu verlassen, soll man wohl untersuchen, wie die Fractur beschaffen; und wenn man etwa spühret, dass Trümmer von den wirbelbeinen gantz abgebrochen, selbige herausnehmen: weswegen man aber oft eine Incision machen muss. Solten Stücke von den gebrochenen Beinen das Rückmark drucken muss man solche entweder mit den Fingern oder mit dienlichen Elevatoriis oder Zangen trachten in die Höhe zu heben, oder wo sie los sind, gantz herauszunehmen. Nachdem muss man suchen die wunde von aller Unreinigkeit wohl zu reinigen."—u.s.w. (Laurentii Heister's Chirurgie, &c. Neue Auflage. 1747, 4, s. 184.)

has the merit of proposing it. *Palmam qui meruit ferat.*" That this was not an expression of opinion formed without due deliberation, and uttered, perhaps, hastily in an oral discourse, is clear from the same statement being repeated in his work on Fractures and Dislocations. When speaking of injuries of the spine, he says, "Mr. Henry Cline was the only person who took a scientific view of this accident. He considers it to be similar to fracture, with depression of the cranium, and to require that the pressure should be removed; and, as the cases had proved so *uniformly fatal*, he thought himself justified in stepping out of the usual course, with the hope of preserving life." . . . "If the operation saves only a life in one hundred, it is more than I have yet seen accomplished by surgery." But more than this, Sir Astley gave practical proof of his approval of the proposal by operating in a case in which there was supposed to be fracture with displacement; it turned out, however, to be merely a fracture of the spinous process, of a dorsal vertebra at its root, and therefore the arch was not meddled with.

Mr. South, of St. Thomas's Hospital, has advocated this operation, which he himself performed on one occasion, although without success. His excellent observations on the subject, in the notes to his translation of Chelius' Surgery, are well known. As regards the violence supposed by some to be necessary in the performance of the operation, and with reference to the patient's suffering, he says:—"I can only say that in Tyrrell's operation which I witnessed, and in that which I performed, no violence was either required or used; in neither did the patient suffer much, nor was his condition rendered worse, but in Tyrrell's case immediately improved." I may add, that in my patient's case the operation was not attended with much suffering; although during a great part of the time he was not thoroughly under the influence of chloroform, but was speaking to those around; the bystanders were surprised how little he seemed to suffer.

Mr. South discusses the question of operation with great clearness

almost the same; his words are:—"If the spinal marrow is wounded, death follows inevitably; though as it may seem cruel not to attempt the relief of one under these unhappy circumstances, the surgeon should lay the injured part bare by the knife, and elevate the fragments which press upon the medulla, in a proper manner; or when they are quite loose, extract them. Then let him cleanse the wound thoroughly, and apply balsamic medicines, using the napkin and scapulary. He must continue this till the wound is healed or the patient dies."

and candour; and, although led to form a judgment in its favour, he admits what I agree with him in thinking to be the most reasonable objection made to it, as well as by far the weightiest, which can at present be urged against it; this is simply the difficulty of accurate diagnosis in cases of supposed fracture of the spine. But the argument derived from difficulty of diagnosis is common to a great number of obscure surgical affections, without its being considered sufficient to give rise to an established rule, that on that account operative interference is not to be contemplated. If I understand rightly the views of those who are in favour of the operation, they ask nothing more than this: that it shall be acknowledged that in certain cases this operation is justifiable; that it shall not be taught in our schools, that as a matter of course, in all cases of fractured spine operation is worse than useless, and not to be thought of; but that the proceeding of trephining the spine shall be permitted to take its place among the legitimate operations of surgery, as one which although formidable, and in most cases not likely to prove successful, nevertheless holds out by far a better prospect of saving life than the system of doing nothing.

It is in the highest degree interesting in scientific questions to find persons starting from different points, or at least pursuing different routes, yet arriving at the same conclusion. Such is in itself strong testimony in favour of the justness of the conclusion arrived at. When we find, therefore, such a man as Dr. Brown-Séquard, who views the question now under consideration more as a physiologist than as a surgeon, and when we find that as a physiologist he is led strenuously to advocate the operation of trephining the spine, we have in this fact additional evidence in its favour. For my own part, I consider Dr. Brown-Séquard's reasoning upon this subject to be unanswered and unanswerable. I say unanswerable, because I regard Mr Shaw's criticism as quite unsatisfactory. Dr. Brown-Séquard, indeed, goes too far when he says, that "these various operations ought to be employed in *almost all* cases of fracture of the spine;" but when Mr. Alexander Shaw accuses him of "omitting to inform us how the patient—thus all but completely decollated, the muscles of the neck extensively cut, the vertebræ deprived of their posterior arches, their bodies broken across, and the ligaments between them ruptured—should be able to hold up his head, or prevent its rolling to and fro, so as to crush the cord supposed, before the operation, to be sound," he speaks without reflecting; he forgets that in Jones' case, at least, this

“complete decollation” did not occur, and that in truth, the ligaments connecting the bodies, transverse and articulating processes, are hardly ever so entirely lacerated as to permit of its occurrence. Even when the body of a vertebra is artificially severed, the parts are still so firmly held together that the removal of the posterior arch does not materially weaken the union caused by the ligamentous structures. This I can state from having made the trial on the dead subject.

It is quite obvious, however, that in case of operation in the cervical region, a suitable appliance to keep the head and spinal column immovable would be indispensably necessary. Jones speaks of the necessity for some such apparatus in cases like his, and he thinks that the application of some well constructed appliance might have obviated the fatal issue in that instance.

It is needless for me to recapitulate Dr. Brown-Séguard’s^a arguments; those interested in the subject will peruse them for themselves. But there is one topic of which he speaks of such vast practical importance that I must be allowed to dwell upon it at some length.

The proposition which it is all important to bear in mind in the present discussion, *that death after fracture of the spine usually is due to pressure or some excitation of the spinal marrow, not to partial or complete section of this organ*, will be readily admitted by those who have had leisure to follow the teachings of modern physiology on this subject. They will know that the disturbance of the functions of sensation and motion, are of little consequence in these cases when compared with the disturbance of the vaso-motor functions of the cord. The presiding influence which the spinal cord exercises over the blood vessels, the disturbance of which produces such remarkable effects upon nutrition, secretion, and temperature, is the function, the consideration of which in cases of fractured spine, demands our real attention. Patients do not die because they have lost sensation, or motion in their lower limbs, or half their body. They usually die from the alterations of secretion and nutrition, the principal evidence of which we find in the rapid atrophy, the sloughing and bed sores, the changed condition of the urinary secretion, the inflammation of bladder, ureters, and kidneys, which constitute so terrible a train of symptoms. The experimental physiologist very well knows that morbid excitation of the cord is

^a Lectures on the Physiology and Pathology of The Central Nervous System. Appendix, p. 245.

the cause of these disturbances, and that a more or less complete section of the cord does not give rise to them, or at least does not cause them to so great a degree, as the prolonged morbid excitation resulting from pressure, or from the driving in of a spicula of bone.

It is therefore a physiological truth which the surgeon should ever have present to his mind, that morbid excitation of the cord resulting from pressure, is the cause of the train of symptoms, which in the cases under consideration, he has the greatest reason to dread. If he can remove the pressure he does all that human skill can do to get rid of the excitation which (unless the injury be high up), step by step gives rise to excoriations, bed sores, sloughing, alkaline urine, inflammation of the bladder, urinary passages, and kidneys. As I have already said, by removing pressure, the surgeon does all that can be done to break the chain of sequences, which when uninterrupted, leads the patient suffering from fractured spine so inevitably to the grave. But it may be said, the experimental physiologist may have no difficulty in admitting the foregoing proposition; he may know that Henry Cline, and many others, have found that animals recover after section of the cord; he may know that it is not section of the cord but persistent irritation of it from some cause which gives rise to disturbance of the nutritive and secretive functions; but what proof have we that such is the case in man. There is indeed proof enough to satisfy the most sceptical. I have myself seen two cases of wound of the spinal cord in man, made by cutting instruments—one in the London Hospital, another at the National Hospital for the Paralyzed and the Epileptic, London—in neither, although paralysis of motion and sensation existed corresponding to the amount of injury done to the medulla, was there sloughing, alkaline urine, inflammation of the bladder, &c. But in proof of the foregoing proposition I shall content myself by referring to two cases:—

“CASE III.^a—A drummer of the National Guard of Paris had a quarrel with one of his comrades, who was drunk, and who, not being able to reach him, flung his sabre at him from a considerable distance, just as he was retreating, and had his back towards his antagonist. The point of the instrument reached the upper and back part of the neck. The wounded man at once found his legs give way under him and fell. He was conveyed next day to the

^a Boyer, “*Traité des Maladies Chirurgicales*,” Tom. vii. p. 9.

hospital of La Charité. The wound, the borders of which were a little contused, was about two inches in extent; it was situated immediately below the occiput, in the upper and back part of the neck and on the right side. The finger could neither discover the depth of it nor penetrate to the vertebral column. The right arm had lost its power of movement, but preserved its sensibility. The right leg seemed somewhat weakened, but was normally sensitive. There was slight difficulty in breathing; pulse frequent, strong and full. He was bled, &c. On the fourth day the weakness of the right leg had entirely disappeared; the patient was able to make some slight motion of extension of the forearm, but could not spontaneously make an attempt at restoring it to the state of flexion.

“On the thirteenth day the patient had recovered his strength and his appetite—he got up and walked; but the paralysis of the upper extremity was the same. When playing tricks with a wardsmen who pinched him, he perceived that the left side of the body was insensible. He told me of it the next day, and I observed the following phenomena:—The left lower limb and the left side of the trunk were of the ordinary size, and possessed their power of movement and their usual agility; but the skin of all these parts might be pinched, pricked, and even cut without the patient feeling it or giving the least sign of pain; pins were stuck in to the depth of three or four lines, and when his head was turned away the man did not perceive it. However, extensive contact, as the application of the hand laid on flat and moved over the surface, gave rise to a sort of sensation, but very slight and obscure. This insensibility existed in the entire extent of the left foot, leg, and thigh; it was equally complete over the left side of the abdomen, but it ceased abruptly in front and behind, at the middle line, with this remarkable peculiarity, that in this locality, if the patient was pinched on the left side, he asserted that he felt a sensation, though feebly, at a corresponding point on the right side. A similar demarcation between the right and left side extended to the skin of the penis and scrotum. The insensibility was complete up to the left side of the base of the thorax; but at a little higher level an obscure sensation began to be perceived, which became more distinct higher up, so that at the level of the fourth rib the skin had natural sensibility. The left limb was in a perfectly natural condition. Twenty days after his accident this man left the hospital cured of the wound in his neck, and having no pain or uneasiness in this part; but the right arm, forearm, and hand were almost completely

paralysed, and the left side of the body, excepting the upper limb, were in a state of insensibility which has just been described. Some months after he revisited the hospital; his condition was little changed. The situation of the wound, and the symptoms with which it was accompanied, induced one to believe that the spinal marrow had been engaged.

The second case was one of the most dreadful that I have ever had an opportunity of witnessing:—

“John Neal,^a a tinplate-worker, was admitted into the Whitworth Hospital, January 31, 1861. He was a thin, delicate-looking man, and presented palpable signs of having suffered severely from syphilis; his skin bore the marks of phagedenic ulceration; the right eye had been the seat of severe inflammation, the pupil was contracted and irregular, and vision impaired; and the left testis enlarged and indurated.

“On admission, he complained of a sense of constriction round his waist, of a difficulty in standing upright, and of general debility. A week afterwards he began to experience difficulty in passing water, and the urine became alkaline and offensive. On the 11th of February he had a rigor, and walked with a staggering gait; and on the 15th, paraplegia was almost completely established, and the sensibility of the lower extremities was somewhat impaired.

“On the 20th, constitutional symptoms of an alarming character were observed, resembling those which follow the infliction of a severe injury. There was cold perspiration over the surface, the pulse was weak and intermittent, and there was frequent vomiting.

“From the 1st of March to the 15th, whilst terrible bed sores were forming, a change was observed in the phenomena of the paraplegia. Some degree of voluntary power was regained in the left foot and leg; the former could be flexed and extended, and the latter drawn up in bed to a certain extent; no such improvement, however, took place in the other limb; but in this the reflex muscular movements regained much of their normal activity, whilst there was a partial recovery of sensibility in both limbs. Whilst, therefore, sensibility was equally impaired in both lower limbs, these extremities were contrasted in the degree of voluntary and of reflected muscular motion which they possessed.

“On the 15th of March, the sloughing had reached a shocking

^a Case by Dr. M'Dowel, Proceedings of Pathological Society, April 6th, 1861, p. 173.

extent; branches of the gluteal artery poured out florid blood at each dressing, and a large portion of the left sciatic nerve was completely exposed. The sufferings of the patient were now very severe; yet in spite of the profuse discharge, the bleedings and consequent hectic, he lingered until the 2nd of April, when he died, emaciated to the last degree. The ravages made by the sloughs were such, that not only was the sacrum exposed and partly softened, but the small rotator muscles and the gluteal nerve on one side, and on the other even the capsular ligament of the hip-joint, were plainly exposed to view.

“Sixteen hours after death the spinal cord was carefully removed. In the centre of its dorsal portion, but extending considerably to the right of the middle line, a tumour of firm consistence and yellow colour was exposed, when a vertical section of the cord was made. It was of the size of a large pea, of a globular form, and smooth on its surface and section; the cord above and below it was softened, and in parts abnormally vascular. In the centre of one area of vascularity a small yellowish spot was observed. There was no trace of tubercles either in the brain, lungs, or liver. The bladder was contracted and inflamed.”

In one of these cases we see that a partial section of the spinal cord did not occasion to any formidable extent, disturbance of the functions of secretion and nutrition; while in the second, a small tumour producing morbid excitation of the medulla, just as the pressure of bone does, was followed by the most terrible ravages.

In the latter case, had it been possible to know the true state of things, it would have rendered the patient's condition less dreadful to have cut the cord clean across above the disease; and, I believe that in many cases of fractured spine, it would be better for the patient to have the medulla cut across above the injury than to have it left subject to the pressure and irritation of the displaced bone. Let me not be understood to propose such a proceeding; I only say, that even that would be better than doing nothing to remove the pressure, which is the first origin and main spring of what finally kills the sufferer in the great majority of cases.

We learn from Mr. South, that before undertaking the operation of cutting away that part of the arch of the vertebra which presses the cord, Henry Cline proposed to himself four questions. It is interesting to compare the answers given by Cline to these questions, with those which, profiting by the experience

and knowledge gained since then, may now be given to them. Cline says:—1st. “Will the patient die of the operation?—Probably he will, if the injury be severe.” This question, I presume, means will the operation of itself prove immediately fatal to the patient. Cline probably shared the belief, still indeed held by some, that the exposure of the cord or its membranes, or the accidental letting out of the cerebro-spinal fluid, was excessively dangerous, and likely to cause convulsions and sudden death; he may also, as South suggests, have supposed that exposure of the cord would hasten inflammation and death. We now know that none of the recorded cases have died suddenly; that in no case can it be said that the operation materially hastened the issue to be expected if it had not been performed, and that it has not been followed by meningitis or myelitis, so as to hasten death. In short, no alarming hemorrhage takes place, and in the operation itself, if performed with care, there is no danger.

2nd. “If the cord be much hurt will it recover its functions?—This is unknown; but we do know that if a nerve be divided, it will unite, and the greater part of the spinal cord may be divided in a brute, and yet the animal recover, in proof of which is detailed an experiment which was performed on a bitch. A cut was made at the back of the neck through the muscles, and the yellow substance between the last cervical and first dorsal vertebra having been divided, the handle of a scalpel was pressed firmly down on the cord, and the result was, that the parts behind the division were completely palsied, excepting that the tail continued still capable of a very slight motion, proving that a small portion of the cord was still undivided. With very great care and attention the animal recovered after some months, and resumed all her paces as usual, with the exception of a peculiar movement of her hind limbs in galloping. She was afterwards destroyed, and the spinal cord being examined, was found to have united. This then seemed to be sufficient proof that a spinal cord which had been considerably injured, if not all but entirely torn through, might be re-united and recover its functions.” It is quite certain that the spinal cord may be injured, and afterwards recover its functions. Experiments like Cline’s have proved this over and over again. In repeating Dr. Brown-Séguard’s well-known experiments on the spinal cord, I have often, more or less, completely cut the cord, and have often seen the animals operated upon almost entirely recover from the paralysis resulting from the incision, and rarely known them to die from a section of a lateral half of the cord.

3rd.—“ After the removal of the arch of the vertebra, will the spine be sufficiently strong to support the body?—Probably it will for ordinary purposes, though the patient may not be able to lift heavy weights.” Louis’s case recovered so as to be able to walk with a stick; none of the other cases regained so much power. The result as regards the power of walking is not mentioned in the short notice of Edwards’ case, given in the *British and Foreign Medico-Chirurgical Review*, but through the kindness of my former pupil, Mr. Phillips, of Cyner, in South Wales, I have learned the following particulars regarding this case:—The patient, whose name was Griffiths, was operated upon a considerable time after receiving the injury; he lived for fifteen years after the operation, but never was able to walk; he regained complete control over the bowels and bladder, and became the father of children.

4th.—“ Will a patient recover from a compound fracture of the spine, which by the performance of the operation it becomes?—The nearer a fracture is to the source of the circulation, and the less compact, and consequently more vascular the bone is, the greater is the probability of recovery. Both these advantages are present in the spine, and therefore favour the successful issue of the case.” Experience has answered this question in the affirmative.

There are of course many questions which arise in connexion with this subject, as regards, for instance, the symptoms indicating cases favourable for the operation, or the reverse, and methods of performing the operation in the different regions of the spine, &c.; but such questions are quite secondary to the great one, as to whether the operation of trephining the spine is justifiable or not. It is to the discussion of this that I have confined myself in this communication, and I cannot help believing that the case I have had to report, although unsuccessful, goes a long way in support of the view which I adopt. I sincerely hope that the perusal of its details will induce surgeons to reconsider a subject which must be admitted to be one of the most important within the domain of surgery.

I have made mention in the foregoing pages of a case in which my friend, Dr. Gordon, has performed the operation of trephining the spine. The full details of the case will be, no doubt, laid before the profession as soon as time makes clear the result. As the case is one, in my mind, of extreme importance, and as the patient’s progress for so far is very gratifying to me, inasmuch as Dr. Gordon was, in a great measure, led to undertake the operation

from a careful consideration of the details of Collins' case, and inspection of the injured parts; I have obtained his permission to make the following statement:—

The operation was performed on June 3rd, two months after the accident, and in the same region as in my case. I now write on July 22nd. Just seven weeks, therefore, have elapsed since the operation. Of the wound not so much as half-an-inch in length remains unhealed; a minute portion of bone (weighing nearly two grains) came away; no abscess formed; in fact Mr. Shaw's appalling predictions have not been realized. Motion is in an appreciable degree restored in the lower limbs; sensation has improved; a bed sore which had formed on the back, not larger than half-a-crown, is well; the urine which before the operation was alkaline, containing blood, and copious muco-purulent deposit, and very offensive, is now almost natural in colour, and has been for the last month persistently acid; power over the bladder is restored. The patient's appearance is much improved, and his appetite is good.

Mr. Harman, one of the resident clinical clerks in the Whitworth Hospital, has copied from his note book the following, showing the condition of the urine and bladder succeeding the operation:—

Fourth day after operation.—Urine became acid.

Fifth day after operation.—Urine again alkaline, scalds him in passing.

Eleventh day.—Had a motion from the bowels, of the passage of which he was perfectly conscious, but unable to control. Urine since last date alkaline, drawn off with catheter.

Fourteenth day.—Urine when drawn off, acid, and quite free from blood.

Sixteenth day.—Urine slightly alkaline, and continued neutral for three days when it became acid, and has remained so since (now a month).

Twenty-sixth day.—Can eject the urine from the bladder; and since the beginning of July the power over the bladder is such as to force the water strongly against the side of the vessel in a full stream, and on one occasion to a distance of between two or three feet; urine persistently acid.

The catheter is no longer necessary.

Of course I need not say that as regards the life of this patient, the improvement in the urine, bladder, bed sore, and, I may add, the state of the penis, is by far more important than the return of sensation or any return of motor power.

APPENDIX.

Reference to the Cases in which Operation has been Performed in order to Remove Bone causing Pressure on the Spinal Cord.

No	Name of the Surgeon who operated on the case	Reference to where the case is mentioned or detailed
1	Louis, - -	Archives Générales de Médecine, 1836, p. 397
2	Henry Cline, -	New England Journal of Med. and Surg., Vol. IV., No. 1
3	Wickham, (Winchester), - -	Sir A. Cooper's Lectures, edited by F. Tyrrell, Vol. II., p. 20
4	Attenburrow, -	<i>Ibid</i> , p. 20
5	Oldknow, - -	Sir A. Cooper's Treatise on Dislocations and Fractures, new edition, by Bransby B. Cooper, 1842-8, p. 560, Case 352
6	F. Tyrrell, - -	Lectures of Sir A. Cooper, &c., by Tyrrell, Vol. II., p. 11
7	J. Rhea Barton, -	Treatise on Dislocations and Fractures of the Joints, American edition, by J. D. Godman, p. 461; and Malgaigne Fractures, translated by Packard, p. 343
8	Tyrrell, - -	Lancet, Vol. XI., 1827, p. 625
9	Alban G. Smith,	North American Medical and Surgical Journal, Vol. VIII., 1829, p. 94
10	Holscher, - -	Hannoversche Annalen, f., d. ges., Heilk. Bd. 4, 1839, p. 330
11	South, - -	Chelius' System of Surgery, translated by South, Vol. I., p. 540
12	D. L. Rogers, -	Amer. Jour. of the Med. Sc., Vol. XVI., 1835, p. 91
13	Edwards, - -	British and Foreign Medical Review, Vol. VI., 1838, p. 162
14	S. Laugier, -	Bulletin Chirurgial, T. I., p. 401; and Laugier des Lésions Traumatiques de la Moelle Epinière Thèse de Concours, 1848, p. 133, Obs. 52
15	Potter, - -	New York Journal of Med. and the Collateral Sciences, Vol. IV., 1845, March

No.	Name of the Surgeon who operated on the case	Reference to where the case is mentioned or detailed
16	J. B. Walker, -	A Descriptive Catalogue of the Anatomical Museum of the Boston Society for Medical Improvement, 1847-8, p. 31, No. 141
17	A. Mayer, - -	Walther's and Ammon's Journal der Chirurgie, Bd. 38. 1848, s. 178. Abildung, Taf. 1, Fig. 1-5
18	G. C. Blackman,	Blackman's edit. of Velpeau's Surgery, Vol. II., p. 392; and J. C. Hutchison in Amer. Medical Times, 1861, July 13, p. 21
19	G. C. Blackman,	<i>Ibid</i>
20	G. M. Jones, -	Medical Times and Gazette, 1856, Vol. II., p. 86
21	J. C. Hutchison,	Transactions of the New York State Medical Society, 1861; and Amer. Medic. Times, 1861, July 13, p. 19
22	Stephen Smith, -	Ch. Phelps in New York Journal of Medicine, Vol. VI., 1859, p. 87
23	Blair, - -	Ballingal's Military Surgery, 4th edit., 1852, p. 298; and Essays of Dr. Munro (Secundus)
24	Potter, - -	American Medical Times, January, 1863, p. 17. Case twice operated upon
25	Potter, - -	American Medical Times, January, 1863
26	Heine, - -	Velpeau's Surgery, 1st American edit.

